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CLAIMS

[Claim(s)]
[Claim 1] The solid image display device characterized by being projected from the width of face as which the beam of light of the image on which it consisted of two or more catoptric system allotted near the incident light study system of two or more image delivery systems which project a picture signal on a screen, and said image delivery system, and the projection direction of two or more of said delivery systems was defined in the fixed direction by arrangement of said delivery system and said catoptric system, and it was projected was determined.
[Claim 2] Catoptric system is the solid image display device according to claim 1 characterized by being arranged so that light may be intercepted partially.
[Claim 3] The solid image display device characterized by projecting in the direction which installed the half mirror on the optical path projected on an image, and was able to define two or more optical paths of a solid image display device according to claim 1 or 2.
[Claim 4] The solid image display device characterized by installing an optical-path sensing element on the optical path projected on an image, making a minute include-angle change and projecting two or more optical paths of a solid image display device according to claim 1, 2, or 3 by time sharing.
[Claim 5] An optical-path sensing element is the solid image display device according to claim 4 characterized by being the configuration which consists of a macromolecule layer and a liquid crystal layer, and controls optical diffraction electrically.
[Claim 6] The solid image display device according to claim 4 or 5 characterized by constituting so that a light wave length decomposition means may be established before and after an optical-path sensing element and the white light may not penetrate to said optical-path sensing element.
[Claim 7] It has two or more image delivery systems for projecting a picture signal on a screen, and two or more optical reflective means to reflect each incident light of said image delivery system, respectively. While two or more of said image delivery system and said two or more optical reflective means are arranged so that the projection direction of two or more incident light reflected with said two or more optical reflective means may be defined in the fixed direction and it may be projected on it by said screen The solid image display device characterized by optical-path spacing of each incident light reflected from said optical reflective means making it smaller than the injection width of face of each image delivery system.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention can be effectively used in the field which carries out display observation of the solid image, and relates to an available solid image display device in many fields, such as TV game, 3D television, CAD, art appreciation, and medical data display.
[0002]
[Description of the Prior Art] As a conventional technique, it is a three-dimension display. The following currently introduced to Chihiro Masuda (Sangyo Tosho Publishing) are raised. For example, two kinds of methods which compound a projection unit by the half mirror are p132 drawing 5 .31. Drawing 5 .32 It is shown. The configuration of this three-dimension display is shown in drawing 10 . These things are designed so that the image from the projector on which it was projected may be settled in both-eyes spacing, and the projector of a mirror and the opposite side may be arranged between each projector using a half mirror. It is arranged so that a projector 102 may enter equivalent among projectors 101 and 103, and it is arranged so that a projector 104 may enter equivalent among projectors 103 and 105.
[0003]
[Problem(s) to be Solved by the Invention] However, it is difficult for constraint by the size of a projector to be large, and for a limitation to insert two images in the pitch of both-eyes spacing in one sheet, and to make [many] the number of eyes for a multi-eye three dimentional display (the number or presentation image number of sheets of a projector) at such arrangement, and when an image moves a view to the pitch of both-eyes spacing by 1-2 sheets, the three dimentional display with it is difficult. [a large change of an image and] [natural]
[0004] This invention solves the above-mentioned technical problem, makes [many] the total image number of sheets which inserts many images with both-eyes spacing, and can be displayed, and aims a more natural three dimentional display at implementation ******.
[0005]
[Means for Solving the Problem] This invention is a configuration on which it is projected from the width of face as which the beam of light of the image on which it consisted of two or more catoptric system allotted near the incident light study system of two or more image delivery systems which project a picture signal on a screen, and said image delivery system, and the projection direction of two or more of said delivery systems was defined in the fixed direction by arrangement of said delivery system and said catoptric system, and it was projected was determined in order to attain the above-mentioned purpose.
[0006] Moreover, it is the configuration which installs an optical-path sensing element on the optical path projected on an image, is made to increase the number of sheets of an image which a few makes an include-angle change and can present two or more optical paths of the image delivery system of the above-mentioned configuration by time sharing, and is projected.
[0007]

[Function] According to this invention, it becomes possible to make [many] the number of sheets of the image on which many images can be projected on both-eyes spacing, and it is projected, and an image changes smoothly to change of human being's view. Moreover, the injection width of face of the image on which it is projected is restricted automatically, when observing as a solid image, mixing between each image decreases, and a smooth change of an image and conjointly very natural solid image display become possible.

[0008]

[Example] Hereafter, the example of this invention is explained, referring to a drawing. Drawing 1 shows the basic method of the optical system of the three dimentional display equipment of the example of this invention, and explains the number of delivery systems (projector) as three sets. For 1a-1c, an image delivery system, 2a, and 2b are [an optical path, and 4a and 4b of the mirror of an optical reflective means, and 3a-3c] protection-from-light means.

[0009] Actuation of the basic method of this example constituted as mentioned above is explained. The basic principle which displays a solid image carries out incidence of the image with the binocular parallax known for many years to each eye. This example also follows this principle. Moreover, human being increases a cubic effect further by change (motion parallax) of the image by migration of a look in addition to binocular parallax. For example, although both-eyes spacing is about 6cm, migration of a look is set to dozens of cm only by moving a little head, and its change of an image is large. This example shows coincidence this motion parallax and the above-mentioned binocular parallax, and also displays automatically the solid image with which a current display includes difficult motion parallax.

[0010] In order to display motion parallax automatically, it is important for human being's both-eyes spacing to show as many images as possible, and it is necessary to display about at least three or more images. The main point of this invention realizes this. There is breadth w physically, when it is the usual video projector, it is 15cm to about 20cm which has small breadth, and, as for the image delivery system 1, it is quite larger than 6cm of both-eyes spacing. In this invention, a mirror 2, the protection-from-light means 4, and a projector 1 are arranged like drawing 1 . The incident light way of the image of Projectors 1a and 1c is changed with mirror 2a installed just before the projector lens, and 2b. The changed optical path is set to 3a and 3c, and carries out near in parallel with optical-path 3of projector 1b b, or in parallel. The injection width of face of the optical path by which incident light is emitted to this optical-path conversion and coincidence is restricted. At this time, an important point is a point which can do smaller than each injection width of face of Projectors 1a-1c the pitches p1, p2, and p3 in which an optical path is injected, or spacing of each optical paths 3a-3c. When the injection width of face of incident light is wide, even if it makes the pitch of the optical path injected small, each incident light overlaps, an image is mixed and the image quality of a solid image deteriorates.

[0011] Thus, by projecting the image on which it was projected on the directive screens (the screen which consisted of lenticular lenses, the screen which consisted of eye lenses of a fly, large convex lens, etc.) designed very highly, an observer is migration (or change of an include angle) of spacing projected on each image, and can observe each projection image now. The physical relationship of a projector, a screen, and an observer is shown in drawing 2 . In drawing 2 , it is the projector unit which consists of projector 1 a-c which showed 5 to the lenticular screen and showed 10 to drawing 1 , and 6 is an observer's location. Although each optical path which projects an image here is an parallel example, an optical path which is converged on a screen is sufficient.

[0012] The prototype of a display of motion parallax is made by this system. In the case of drawing 1 , it is a basic form for principle explanation, and it wants the number of sheets of an image for the display of the motion parallax itself by the image of three sheets. Therefore, the display of five images is attained by what increase (1d-1h) and a mirror 2 also increase the number of projectors 1 for as shown in drawing 3 (2c-2f). Moreover, the each opticals axis [at this time / 3d-3h] pitches p4-p8 can be made small to about 2-3cm, and while being 6cm of human being's both-eyes spacing, it becomes possible to project the image of about 3-4 sheets.

[0013] Although the include angle between each projector is 60 degrees in drawing 3 , if the projector of the simple substance settled at 45 degrees can be used, projection of seven images will make the pitch of

each optical path small, will make spacing between optical paths smaller than both-eyes spacing, and projection will become possible.

[0014] When it is necessary to make the number of sheets of an image increase furthermore, a projector is combined as mentioned above, and it considers as a projector unit, and compounds combining between this projector unit with a half mirror, and the number of sheets of an image is made to increase. This combination is shown in drawing 4 . In drawing 4 , 10a and b are the projector units shown in drawing 3 , 11 is a reflecting mirror and 12 is a half mirror. By doing in this way, about the image of ten sheets or 14 sheets, optical-path spacing is narrowed and projection becomes possible. What is necessary is just to have made alignment between images within the projector unit at this time, and to carry out alignment between the projector units compounded by the half mirror. Therefore, also on the conditions whose image number of sheets increases, alignment between images can be performed easily.

[0015] It is also possible to combine four projector units still like drawing 5 . In drawing 5 , 10 a-d is projector units, 11 a-c is the reflecting mirror of an optical reflective means, and 12 a-c is a half mirror. By doing in this way, the projection which narrowed the image of 28 sheets in the case where each include angle between projectors is 60 degrees, and narrowed optical-path spacing in the case of 20 sheets or 45 degrees is attained.

[0016] It becomes possible to be able to project the image of 3-4 sheets on human being's both-eyes spacing in the 1st example by the above configuration, and to project the image of 20-28 sheets on coincidence. Therefore, it is possible for the presentation of movement stereoscopic vision which gives a bigger cubic effect than a binocular vision to be attained, and to realize a three dimentional display with a more natural cubic effect with a binocular vision.

[0017] In addition, the quantity of light falls to 1 / 2 - 1/3 with transparency of one half mirror, and, in the case of drawing 5 , the quantity of light falls with transparency of two half mirrors 1 / 4 - 1/9. Therefore, what constituted the screen from a strong directive large lens (Fresnel lens) of light is suitable. Moreover, it is an approach possible [the approach of making it bright], and good, using a lenticular lens and a Fresnel lens for coincidence, using a Fresnel lens for condensing of the vertical direction, and using observation by the side lobe which is the property of a lenticular lens. The incident light decreased about to 1/9 by the half mirror by the use effectiveness of light becoming high if directivity becomes high can also be observed brightly, and the configuration shown in drawing 5 can also enjoy 3-dimensional scenography sufficiently brightly. Moreover, if compared with the screen of common cloth, it is possible to make it sufficiently bright.

[0018] Drawing 6 is a block diagram in the 2nd example of this invention, and the projector unit which shows 10 to drawing 3 , and 18 and 19 are optical-path conversion means. The 2nd example constituted as mentioned above is explained.

[0019] The configuration of the optical-path conversion means 18 and 19 is shown in drawing 7 . Drawing 7 generalizes the detailed structure of the order which light diffracts, and shows it typically. In drawing 7 , 21 and 22 are glass bases, 23 and 24 are transparent electrodes, 25 is the phase of a macromolecule and liquid crystal, 32 is a macromolecule phase, and 33 is a liquid crystal phase. As structure is shown in drawing 7 (a), the macromolecule phase 32 shown as the continuous line which inclined among drawing, and the liquid crystal phase 33 which is the field across which it faced as said continuous line have started periodic phase separation. The liquid crystal DOROPU let 38 which is the aggregate with the settlement which has a liquid crystal molecule in a liquid crystal phase 33 is formed, this liquid crystal DOROPU let 38 turns to a random direction separately, it is distributing, and the average refractive index of the liquid crystal phase 33 defined equivalent is higher than the refractive index of the macromolecule phase 32. That is, the periodic structure currently formed here forms the so-called volume phase type of hologram by existence of the comparatively big refractive-index difference of a bi-phase. Therefore, the incident light 36 which carries out incidence at a BURAGU include angle is changed into the diffracted light 37, without receiving loss, deflects the course efficient, and takes a different optical path from incident light 36.

[0020] Moreover, if it is pinched by the transparent electrodes 23 and 24 of an optical-path sensing element with the above structures and an electrical potential difference is impressed to a two-electrodes

layer, as shown in drawing 7 (b), since the liquid crystal DOROPU let 38 in a liquid crystal phase 33 will arrange in the direction of electric field and a refractive-index difference with the macromolecule phase 32 will be lost, the force which diffracts light is lost, and incident light 36 turns into the transmitted light 40, and passes an optical-path sensing element. Therefore, light does not advance in the direction in which the diffracted light was observed before impressing an electrical potential difference at this time.

[0021] It becomes possible using the above optical-path sensing elements to change the course of light in the two directions on an electrical potential difference. The direction of two or more images on which this optical-path sensing element is arranged ahead of the projector unit 10, and is projected from a projector unit as shown in 18 of drawing 6 and 19 is changed. The condition of applying an electrical potential difference to an optical-path sensing element, and having made it light penetrate as it is is an optical path 41. In addition, an optical path 41 represents the optical path projected on two or more images of the projector unit 10. Moreover, 42 shows the optical path when not applying an electrical potential difference to the optical-path sensing elements 18 and 19. Thus, it is possible to double the number of the images on which it is projected from a projector unit by using the optical-path sensing element of two sheets, although it is time sharing. Moreover, at least optical-path sensing-element 18 can be doubled for an optical path at this time. Since two optical paths do not become parallel at this time, the optical path of each image of the projector unit 10 is not parallel, either, and as it spread in the radial, when an optical path is changed by the optical-path sensing element, it is necessary to determine an optical-path conversion angle that spacing with the next image is made to become equal, or spacing of an image will become equal on a screen in the case of parallel light. When an electrical potential difference is applied to the optical-path sensing element of two sheets at coincidence using the optical-path sensing element of two sheets, an optical path 43 is taken, as furthermore shown in drawing 8 , when an electrical potential difference is applied only to the optical-path sensing element 17, an optical path 44 is taken, and when an electrical potential difference is applied only to the optical-path sensing element 16, it becomes an optical path 45. Thus, the number of optical paths with which it is projected on an image is increased (it is time sharing), and it becomes possible to project many images on small spacing (for them to be 3 or 4 or more sheets to both-eyes spacing).

[0022] As mentioned above, according to the 2nd example, the increase of an optical path on which an image is projected by time sharing using an optical-path sensing element, and the image number of sheets displayed can be increased further, it becomes possible to give very smooth motion parallax, the display of natural 3-dimensional scenography is conjointly attained with binocular parallax, and the practical value is high.

[0023] In addition, although drawing 6 and drawing 8 showed the configuration which arranges an optical-path sensing element before the projector unit 10 It becomes naturally before a configuration like drawing 5 which increased the image number of sheets on which it is projected by the half mirror, may arrange an optical-path sensing element, and possible to project a further 2 to 3 times (20x2=40 sheet or 28x3=84 sheet) as many image as the maximum number of sheets of the image shown by drawing 5 at this time. When the image of 84 sheets is displayed (for example, when an image is shown at intervals of 2cm), the solid image which has motion parallax and binocular parallax in [large] 1.68m (at least 40 sheets 80cm) can be observed. Therefore, presentation becomes it is satisfactory and possible practical about a natural solid image including motion parallax and binocular parallax.

[0024] Next, the 3rd example which changed how to use an optical-path sensing element is explained. Drawing 9 shows the configuration of the 3rd example of this invention, establishes light wave length decomposition means, such as a dichroic mirror, before and after an optical-path sensing element, and it is what was constituted so that the white light might not penetrate to said optical-path sensing element, and as it is penetrated for every primary color, it realizes high definition-ization.

[0025] In drawing 9 , the dichroic mirror which the dichroic mirror which 10 reflects a projector unit, and 50 reflects red light, and penetrates other colored light, and 51 and 54 reflect green light, the dichroic mirror which penetrates other colored light, and 52 and 53 reflect a reflecting mirror, and 55 reflects blue glow, and penetrates other colored light, and 56, 57 and 58 are optical-path sensing

elements.
[0026] Hereafter, actuation of the 3rd example is explained. The difference from the configuration of drawing 6 and drawing 8 is the point of using an optical-path sensing element for every [of light] wavelength (each primary color). Dichroic mirrors 51 and 52 separate into the primary lights of RGB the light on which it was projected from the projector unit 10. The optical-path sensing elements 56, 57, and 58 are made to act to each separated primary lights, and an optical path is changed in time. Each primary lights from which the optical path was changed are again compounded by dichroic mirrors 54 and 55 and the mirror 53, and turn into image light of a color. The compounded image light is projected in the 59 or 60 directions by time sharing, and makes an optical path increase twice.
[0027] The reason for making an optical-path sensing element act according to each primary lights is shown below. When the optical-path sensing element used by this invention uses the diffraction of light theoretically and the large modification angle of an optical path is taken, a modification angle will change with the wavelength difference of light, and image quality will deteriorate. Therefore, in order to maintain image quality to a high level, it separates into each primary lights and optical-path conversion is performed. By separating into primary lights, a modification angle can be determined for every primary color, and it does not ********, but can project [an image can spread, or] on a right location, and image quality does not deteriorate. When especially the modification angle of an optical path is large, the property in which image quality does not deteriorate serves as the big description.
[0028] As mentioned above, the image number of sheets which there is no degradation of image quality also when the increase of an optical path on which an image is projected by time sharing using an optical-path sensing element for every colored light, and the conversion angle of an optical path are large according to the 3rd example, and is displayed can be increased, it becomes possible to give very smooth motion parallax, the display of natural 3-dimensional scenography is conjointly attained with binocular parallax, and the practical value is high.
[0029] In addition, although the screen used the thing of a transparency mold in the above-mentioned example, if it is a thing powerful type [directive], naturally the thing of a reflective mold may be used.
[0030] Moreover, although a screen is a flat surface in the above-mentioned example, you may project on the screen of a convex or a concave surface. At this time, the observation from various include angles is attained by carrying out the flux of light of the image projection from each projector in the direction (convex projection) which spreads in a flabellate form, and its direction (concave surface projection) which narrows conversely. further -- a part for the projection area of this invention -- increasing -- up to 360 degrees -- correspondence **** -- the projection to a cylindrical screen is also attained by things.
[0031]
[Effect of the Invention] As mentioned above, according to this invention, the image of many of 3-4 or more sheets can be projected on both-eyes spacing, and many images can be projected as a whole, motion parallax and binocular parallax can show coincidence, and an image changes smoothly to change of human being's view. Moreover, the injection width of face of the image on which it is projected is restricted automatically, when observing as a solid image, mixing between each image decreases, it is as natural as a smooth change of an image conjointly, the high image of a cubic effect can be shown, and the practical value is high.
[0032] Moreover, by projecting by time sharing, it is easily possible to increase the number of sheets of a projection image further, it is still more natural, and can present the high image of a cubic effect. Moreover, if it is the same projection number of sheets, it is possible to lessen the number of projectors and a price, magnitude, etc. when realizing concretely of the practical value are high.

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TECHNICAL FIELD

[Industrial Application] This invention can be effectively used in the field which carries out display observation of the solid image, and relates to an available solid image display device in many fields, such as TV game, 3D television, CAD, art appreciation, and medical data display.

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PRIOR ART

[Description of the Prior Art] As a conventional technique, it is a three-dimension display. The following currently introduced to Chihiro Masuda (Sangyo Tosho Publishing) are raised. For example, two kinds of methods which compound a projection unit by the half mirror are p132 drawing 5 .31. Drawing 5 .32 It is shown. The configuration of this three-dimension display is shown in drawing 10 . These things are designed so that the image from the projector on which it was projected may be settled in both-eyes spacing, and the projector of a mirror and the opposite side may be arranged between each projector using a half mirror. It is arranged so that a projector 102 may enter equivalent among projectors 101 and 103, and it is arranged so that a projector 104 may enter equivalent among projectors 103 and 105.

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EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to this invention, the image of many of 3-4 or more sheets can be projected on both-eyes spacing, and many images can be projected as a whole, motion parallax and binocular parallax can show coincidence, and an image changes smoothly to change of human being's view. Moreover, the injection width of face of the image on which it is projected is restricted automatically, when observing as a solid image, mixing between each image decreases, it is as natural as a smooth change of an image conjointly, the high image of a cubic effect can be shown, and the practical value is high.
[0032] Moreover, by projecting by time sharing, it is easily possible to increase the number of sheets of a projection image further, it is still more natural, and can present the high image of a cubic effect. Moreover, if it is the same projection number of sheets, it is possible to lessen the number of projectors and a price, magnitude, etc. when realizing concretely of the practical value are high.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, it is difficult for constraint by the size of a projector to be large, and for a limitation to insert two images in the pitch of both-eyes spacing in one sheet, and to make [many] the number of eyes for a multi-eye three dimentional display (the number or presentation image number of sheets of a projector) at such arrangement, and when an image moves a view to the pitch of both-eyes spacing by 1-2 sheets, the three dimentional display with it is difficult. [a large change of an image and] [natural]
[0004] This invention solves the above-mentioned technical problem, makes [many] the total image number of sheets which inserts many images with both-eyes spacing, and can be displayed, and aims a more natural three dimentional display at implementation ******.

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MEANS

[Means for Solving the Problem] This invention is a configuration on which it is projected from the width of face as which the beam of light of the image on which it consisted of two or more catoptric system allotted near the incident light study system of two or more image delivery systems which project a picture signal on a screen, and said image delivery system, and the projection direction of two or more of said delivery systems was defined in the fixed direction by arrangement of said delivery system and said catoptric system, and it was projected was determined in order to attain the above-mentioned purpose.
[0006] Moreover, it is the configuration which installs an optical-path sensing element on the optical path projected on an image, is made to increase the number of sheets of an image which a few makes an include-angle change and can present two or more optical paths of the image delivery system of the above-mentioned configuration by time sharing, and is projected.

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OPERATION

[Function] According to this invention, it becomes possible to make [many] the number of sheets of the image on which many images can be projected on both-eyes spacing, and it is projected, and an image changes smoothly to change of human being's view. Moreover, the injection width of face of the image on which it is projected is restricted automatically, when observing as a solid image, mixing between each image decreases, and a smooth change of an image and conjointly very natural solid image display become possible.

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EXAMPLE

[Example] Hereafter, the example of this invention is explained, referring to a drawing. Drawing 1 shows the basic method of the optical system of the three dimentional display equipment of the example of this invention, and explains the number of delivery systems (projector) as three sets. For 1a-1c, an image delivery system, 2a, and 2b are [an optical path, and 4a and 4b of the mirror of an optical reflective means, and 3a-3c] protection-from-light means.
[0009] Actuation of the basic method of this example constituted as mentioned above is explained. The basic principle which displays a solid image carries out incidence of the image with the binocular parallax known for many years to each eye. This example also follows this principle. Moreover, human being increases a cubic effect further by change (motion parallax) of the image by migration of a look in addition to binocular parallax. For example, although both-eyes spacing is about 6cm, migration of a look is set to dozens of cm only by moving a little head, and its change of an image is large. This example shows coincidence this motion parallax and the above-mentioned binocular parallax, and also displays automatically the solid image with which a current display includes difficult motion parallax.
[0010] In order to display motion parallax automatically, it is important for human being's both-eyes spacing to show as many images as possible, and it is necessary to display about at least three or more images. The main point of this invention realizes this. There is breadth w physically, when it is the usual video projector, it is 15cm to about 20cm which has small breadth, and, as for the image delivery system 1, it is quite larger than 6cm of both-eyes spacing. In this invention, a mirror 2, the protection-from-light means 4, and a projector 1 are arranged like drawing 1 . The incident light way of the image of Projectors 1a and 1c is changed with mirror 2a installed just before the projector lens, and 2b. The changed optical path is set to 3a and 3c, and carries out near in parallel with optical-path 3of projector 1b b, or in parallel. The injection width of face of the optical path by which incident light is emitted to this optical-path conversion and coincidence is restricted. At this time, an important point is a point which can do smaller than each injection width of face of Projectors 1a-1c the pitches p1, p2, and p3 in which an optical path is injected, or spacing of each optical paths 3a-3c. When the injection width of face of incident light is wide, even if it makes the pitch of the optical path injected small, each incident light overlaps, an image is mixed and the image quality of a solid image deteriorates.
[0011] Thus, by projecting the image on which it was projected on the directive screens (the screen which consisted of lenticular lenses, the screen which consisted of eye lenses of a fly, large convex lens, etc.) designed very highly, an observer is migration (or change of an include angle) of spacing projected on each image, and can observe each projection image now. The physical relationship of a projector, a screen, and an observer is shown in drawing 2 . In drawing 2 , it is the projector unit which consists of projector 1 a-c which showed 5 to the lenticular screen and showed 10 to drawing 1 , and 6 is an observer's location. Although each optical path which projects an image here is an parallel example, an optical path which is converged on a screen is sufficient.
[0012] The prototype of a display of motion parallax is made by this system. In the case of drawing 1 , it is a basic form for principle explanation, and it wants the number of sheets of an image for the display of the motion parallax itself by the image of three sheets. Therefore, the display of five images is attained

by what increase (1d-1h) and a mirror 2 also increase the number of projectors 1 for as shown in drawing 3 (2c-2f). Moreover, the each opticals axis [at this time / 3d-3h] pitches p4-p8 can be made small to about 2-3cm, and while being 6cm of human being's both-eyes spacing, it becomes possible to project the image of about 3-4 sheets.

[0013] Although the include angle between each projector is 60 degrees in drawing 3 , if the projector of the simple substance settled at 45 degrees can be used, projection of seven images will make the pitch of each optical path small, will make spacing between optical paths smaller than both-eyes spacing, and projection will become possible.

[0014] When it is necessary to make the number of sheets of an image increase furthermore, a projector is combined as mentioned above, and it considers as a projector unit, and compounds combining between this projector unit with a half mirror, and the number of sheets of an image is made to increase. This combination is shown in drawing 4 . In drawing 4 , 10a and b are the projector units shown in drawing 3 , 11 is a reflecting mirror and 12 is a half mirror. By doing in this way, about the image of ten sheets or 14 sheets, optical-path spacing is narrowed and projection becomes possible. What is necessary is just to have made alignment between images within the projector unit at this time, and to carry out alignment between the projector units compounded by the half mirror. Therefore, also on the conditions whose image number of sheets increases, alignment between images can be performed easily.

[0015] It is also possible to combine four projector units still like drawing 5 . In drawing 5 , 10 a-d is projector units, 11 a-c is the reflecting mirror of an optical reflective means, and 12 a-c is a half mirror. By doing in this way, the projection which narrowed the image of 28 sheets in the case where each include angle between projectors is 60 degrees, and narrowed optical-path spacing in the case of 20 sheets or 45 degrees is attained.

[0016] It becomes possible to be able to project the image of 3-4 sheets on human being's both-eyes spacing in the 1st example by the above configuration, and to project the image of 20-28 sheets on coincidence. Therefore, it is possible for the presentation of movement stereoscopic vision which gives a bigger cubic effect than a binocular vision to be attained, and to realize a three dimentional display with a more natural cubic effect with a binocular vision.

[0017] In addition, the quantity of light falls to 1 / 2 - 1/3 with transparency of one half mirror, and, in the case of drawing 5 , the quantity of light falls with transparency of two half mirrors 1 / 4 - 1/9. Therefore, what constituted the screen from a strong directive large lens (Fresnel lens) of light is suitable. Moreover, it is an approach possible [the approach of making it bright], and good, using a lenticular lens and a Fresnel lens for coincidence, using a Fresnel lens for condensing of the vertical direction, and using observation by the side lobe which is the property of a lenticular lens. The incident light decreased about to 1/9 by the half mirror by the use effectiveness of light becoming high if directivity becomes high can also be observed brightly, and the configuration shown in drawing 5 can also enjoy 3-dimensional scenography sufficiently brightly. Moreover, if compared with the screen of common cloth, it is possible to make it sufficiently bright.

[0018] Drawing 6 is a block diagram in the 2nd example of this invention, and the projector unit which shows 10 to drawing 3 , and 18 and 19 are optical-path conversion means. The 2nd example constituted as mentioned above is explained.

[0019] The configuration of the optical-path conversion means 18 and 19 is shown in drawing 7 . Drawing 7 generalizes the detailed structure of the order which light diffracts, and shows it typically. In drawing 7 , 21 and 22 are glass bases, 23 and 24 are transparent electrodes, 25 is the phase of a macromolecule and liquid crystal, 32 is a macromolecule phase, and 33 is a liquid crystal phase. As structure is shown in drawing 7 (a), the macromolecule phase 32 shown as the continuous line which inclined among drawing, and the liquid crystal phase 33 which is the field across which it faced as said continuous line have started periodic phase separation. The liquid crystal DOROPU let 38 which is the aggregate with the settlement which has a liquid crystal molecule in a liquid crystal phase 33 is formed, this liquid crystal DOROPU let 38 turns to a random direction separately, it is distributing, and the average refractive index of the liquid crystal phase 33 defined equivalent is higher than the refractive index of the macromolecule phase 32. That is, the periodic structure currently formed here forms the so-

called volume phase type of hologram by existence of the comparatively big refractive-index difference of a bi-phase. Therefore, the incident light 36 which carries out incidence at a BURAGU include angle is changed into the diffracted light 37, without receiving loss, deflects the course efficient, and takes a different optical path from incident light 36.

[0020] Moreover, if it is pinched by the transparent electrodes 23 and 24 of an optical-path sensing element with the above structures and an electrical potential difference is impressed to a two-electrodes layer, as shown in drawing 7 (b), since the liquid crystal DOROPU let 38 in a liquid crystal phase 33 will arrange in the direction of electric field and a refractive-index difference with the macromolecule phase 32 will be lost, the force which diffracts light is lost, and incident light 36 turns into the transmitted light 40, and passes an optical-path sensing element. Therefore, light does not advance in the direction in which the diffracted light was observed before impressing an electrical potential difference at this time.

[0021] It becomes possible using the above optical-path sensing elements to change the course of light in the two directions on an electrical potential difference. The direction of two or more images on which this optical-path sensing element is arranged ahead of the projector unit 10, and is projected from a projector unit as shown in 18 of drawing 6 and 19 is changed. The condition of applying an electrical potential difference to an optical-path sensing element, and having made it light penetrate as it is is an optical path 41. In addition, an optical path 41 represents the optical path projected on two or more images of the projector unit 10. Moreover, 42 shows the optical path when not applying an electrical potential difference to the optical-path sensing elements 18 and 19. Thus, it is possible to double the number of the images on which it is projected from a projector unit by using the optical-path sensing element of two sheets, although it is time sharing. Moreover, at least optical-path sensing-element 18 can be doubled for an optical path at this time. Since two optical paths do not become parallel at this time, the optical path of each image of the projector unit 10 is not parallel, either, and as it spread in the radial, when an optical path is changed by the optical-path sensing element, it is necessary to determine an optical-path conversion angle that spacing with the next image is made to become equal, or spacing of an image will become equal on a screen in the case of parallel light. When an electrical potential difference is applied to the optical-path sensing element of two sheets at coincidence using the optical-path sensing element of two sheets, an optical path 43 is taken, as furthermore shown in drawing 8 , when an electrical potential difference is applied only to the optical-path sensing element 17, an optical path 44 is taken, and when an electrical potential difference is applied only to the optical-path sensing element 16, it becomes an optical path 45. Thus, the number of optical paths with which it is projected on an image is increased (it is time sharing), and it becomes possible to project many images on small spacing (for them to be 3 or 4 or more sheets to both-eyes spacing).

[0022] As mentioned above, according to the 2nd example, the increase of an optical path on which an image is projected by time sharing using an optical-path sensing element, and the image number of sheets displayed can be increased further, it becomes possible to give very smooth motion parallax, the display of natural 3-dimensional scenography is conjointly attained with binocular parallax, and the practical value is high.

[0023] In addition, although drawing 6 and drawing 8 showed the configuration which arranges an optical-path sensing element before the projector unit 10 It becomes naturally before a configuration like drawing 5 which increased the image number of sheets on which it is projected by the half mirror, may arrange an optical-path sensing element, and possible to project a further 2 to 3 times (20x2=40 sheet or 28x3=84 sheet) as many image as the maximum number of sheets of the image shown by drawing 5 at this time. When the image of 84 sheets is displayed (for example, when an image is shown at intervals of 2cm), the solid image which has motion parallax and binocular parallax in [large] 1.68m (at least 40 sheets 80cm) can be observed. Therefore, presentation becomes it is satisfactory and possible practical about a natural solid image including motion parallax and binocular parallax.

[0024] Next, the 3rd example which changed how to use an optical-path sensing element is explained. Drawing 9 shows the configuration of the 3rd example of this invention, establishes light wave length decomposition means, such as a dichroic mirror, before and after an optical-path sensing element, and it

is what was constituted so that the white light might not penetrate to said optical-path sensing element, and as it is penetrated for every primary color, it realizes high definition-ization.
[0025] In drawing 9 , the dichroic mirror which the dichroic mirror which 10 reflects a projector unit, and 50 reflects red light, and penetrates other colored light, and 51 and 54 reflect green light, the dichroic mirror which penetrates other colored light, and 52 and 53 reflect a reflecting mirror, and 55 reflects blue glow, and penetrates other colored light, and 56, 57 and 58 are optical-path sensing elements.
[0026] Hereafter, actuation of the 3rd example is explained. The difference from the configuration of drawing 6 and drawing 8 is the point of using an optical-path sensing element for every [of light] wavelength (each primary color). Dichroic mirrors 51 and 52 separate into the primary lights of RGB the light on which it was projected from the projector unit 10. The optical-path sensing elements 56, 57, and 58 are made to act to each separated primary lights, and an optical path is changed in time. Each primary lights from which the optical path was changed are again compounded by dichroic mirrors 54 and 55 and the mirror 53, and turn into image light of a color. The compounded image light is projected in the 59 or 60 directions by time sharing, and makes an optical path increase twice.
[0027] The reason for making an optical-path sensing element act according to each primary lights is shown below. When the optical-path sensing element used by this invention uses the diffraction of light theoretically and the large modification angle of an optical path is taken, a modification angle will change with the wavelength difference of light, and image quality will deteriorate. Therefore, in order to maintain image quality to a high level, it separates into each primary lights and optical-path conversion is performed. By separating into primary lights, a modification angle can be determined for every primary color, and it does not ********, but can project [an image can spread, or] on a right location, and image quality does not deteriorate. When especially the modification angle of an optical path is large, the property in which image quality does not deteriorate serves as the big description.
[0028] As mentioned above, the image number of sheets which there is no degradation of image quality also when the increase of an optical path on which an image is projected by time sharing using an optical-path sensing element for every colored light, and the conversion angle of an optical path are large according to the 3rd example, and is displayed can be increased, it becomes possible to give very smooth motion parallax, the display of natural 3-dimensional scenography is conjointly attained with binocular parallax, and the practical value is high.
[0029] In addition, although the screen used the thing of a transparency mold in the above-mentioned example, if it is a thing powerful type [directive], naturally the thing of a reflective mold may be used.
[0030] Moreover, although a screen is a flat surface in the above-mentioned example, you may project on the screen of a convex or a concave surface. At this time, the observation from various include angles is attained by carrying out the flux of light of the image projection from each projector in the direction (convex projection) which spreads in a flabellate form, and its direction (concave surface projection) which narrows conversely. further -- a part for the projection area of this invention -- increasing -- up to 360 degrees -- correspondence **** -- the projection to a cylindrical screen is also attained by things.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the outline of an example of the configuration of the solid image display device of the 1st example of this invention
[Drawing 2] Drawing showing the screen of the solid image display device of the 1st example of this invention, an observer's physical relationship, and an example of an optical path
[Drawing 3] Drawing showing the outline of other examples of a configuration of the solid image display device of the 1st example of this invention
[Drawing 4] Drawing showing other examples of a configuration of the image delivery system of the 1st example of this invention
[Drawing 5] Drawing showing the example of a configuration of further others of the image delivery system of the 1st example of this invention
[Drawing 6] Drawing showing an example of the configuration of the solid image display device of the 2nd example of this invention
[Drawing 7] (a) and (b) are drawing showing the outline of the optical-path sensing element of the solid image display device of this 2nd example.
[Drawing 8] Drawing showing other examples of a configuration of the solid image display device of the 2nd example of this invention
[Drawing 9] Drawing showing the example of a configuration of the solid image display device of the 3rd example of this invention
[Drawing 10] Drawing showing the configuration of the conventional solid image display device
[Description of Notations]
1 Image Delivery System
2 Mirror
4 Protection-from-Light Means
5 Lenticular Screen
10 Projector Unit
11 Reflecting Mirror
12 Half Mirror
16, 17, 18, 19 Optical-path conversion means
50, 51, 54, 55 Dichroic mirror
56, 57, 58 Optical-path conversion means

[Translation done.]

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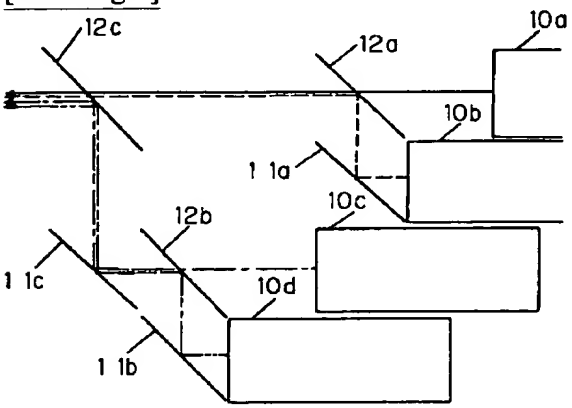
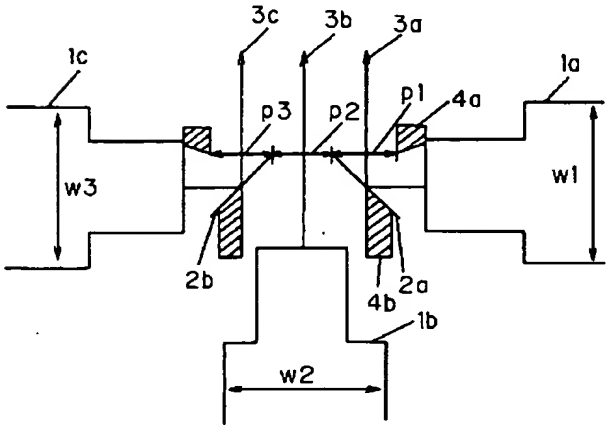
DRAWINGS

[Drawing 5]

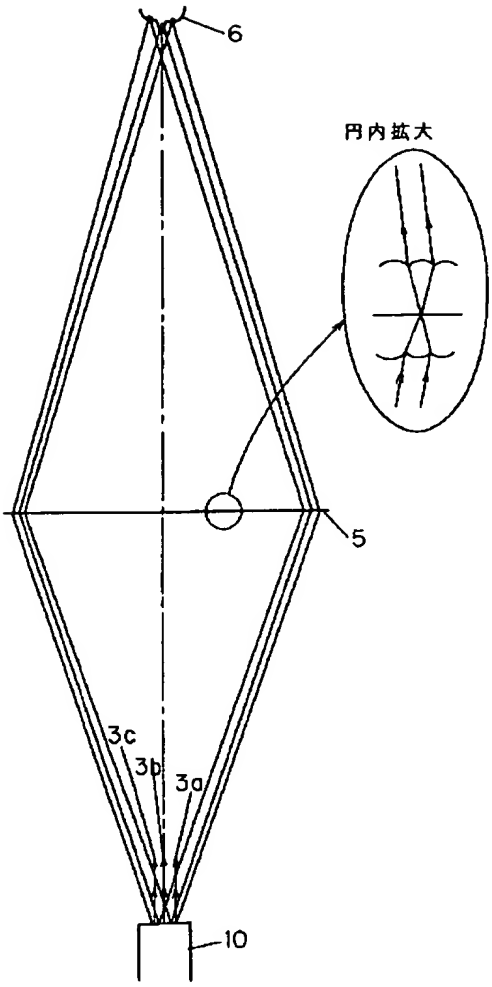


[Drawing 1]

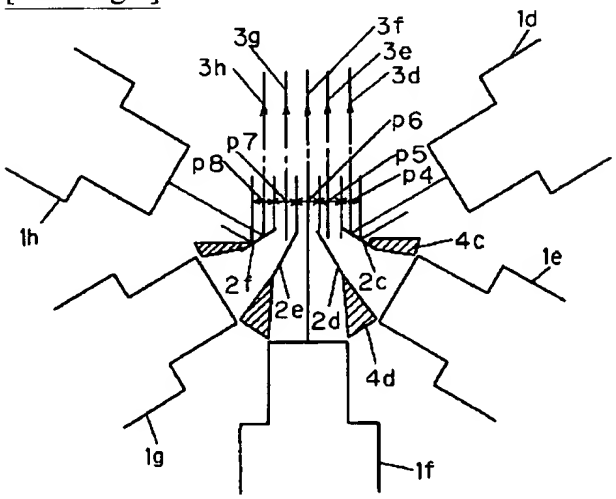
1a~1c 画像投射手段
2a,2b 光学反射手段
3a~3c 光路



[Drawing 2]

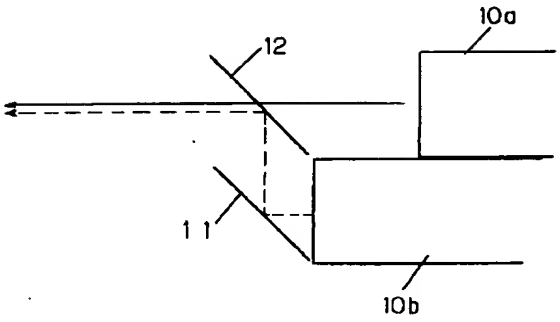


[Drawing 3]

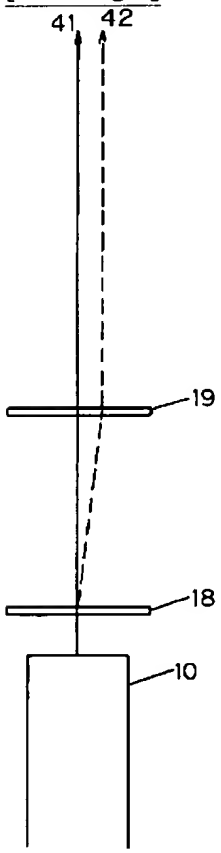


[Drawing 4]

11 反射鏡
12 ハーフミラー



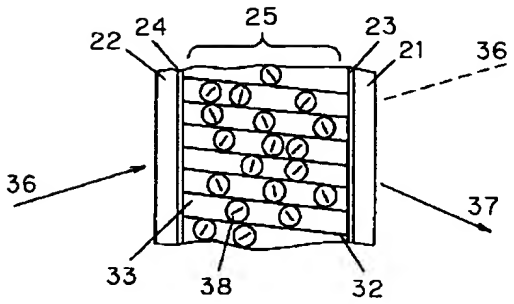
[Drawing 6]



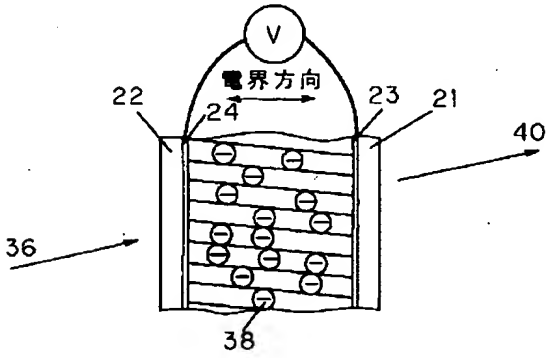
[Drawing 7]

12 高分子相
13 液晶相
16 入射光
17 回折光
18 液晶ドロプレット
19 観察者
20 透過光

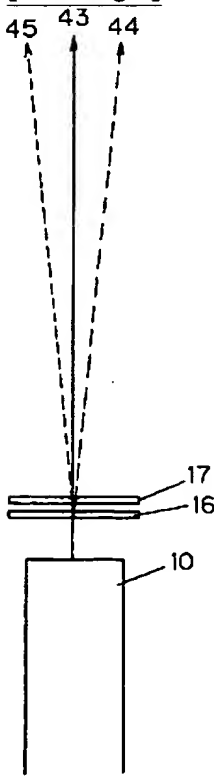
(a)



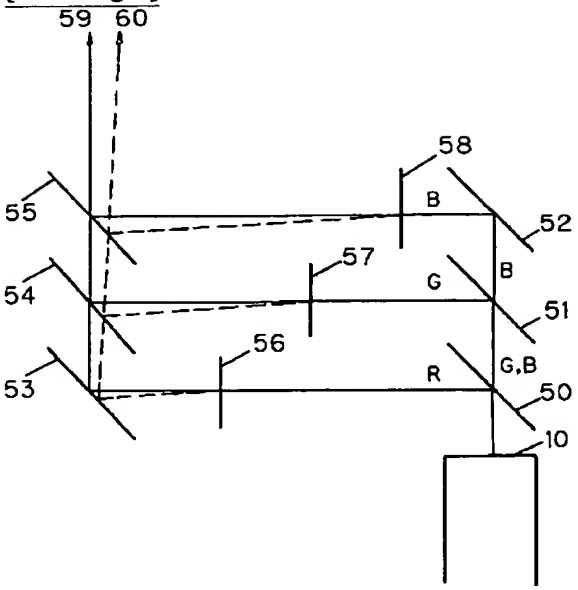
(b)



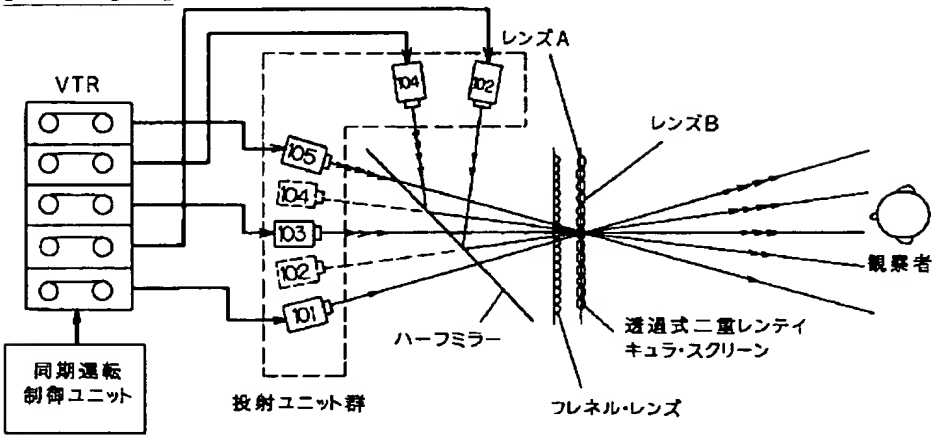
[Drawing 8]



[Drawing 9]



[Drawing 10]



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